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Nature exposure sufficiency and insufficiency: The benefits of environmental preservation☆

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ABSTRACT

Increasing industrialization, urbanization, and a failure of many world leaders to appreciate the consequences of climate change are deleteriously impacting quality of life as well as diminishing the prospects for long term survival. Economic competitiveness and corporate profitability often pre-empt environmental concerns. The calving of an iceberg in Antarctica and the hurricane activity in the Caribbean during 2017 are unfortunate illustrations of the continuing escalation of environmental issues. We provide historical and current evidence for the importance of Nature Exposure (NE) and introduce the continuum Nature Exposure Sufficiency (NES) and Insufficiency (NEI). Insufficiency includes impoverished environments (e.g., slums and prisons) where nature exposure is very limited. Nature Exposure Sufficiency (NES) is an optimal amount of exposure to nature where many benefits such as reinvigoration can be obtained by everyone. NES also has several benefits for individuals with various health conditions such as arthritis, dementia, or depression. The benefits of NE are not just derivable from parks, forests, and other natural settings. Interiors of buildings and homes can be enhanced with plants and even pictures or objects from nature. Additionally, there is abundant evidence indicating that virtual and artificial environments depicting nature can provide substantial NE and therefore contribute to general wellbeing. Besides the difficulty in achieving cooperation amongst nations, corporations, and other collectives in developing and implementing long range plans to deal with climate change, there is also sometimes an aversion at the individual level whereby people are unwilling to experience nature due to insects and other discomforts. Such individuals are often averse to supplanting the comforts of home, even temporarily, with inadequate facilities that are seemingly less pleasant than their typical dwellings. We propose using the term Nature Exposure Aversion (NEA) to describe such behavior and propose that the aversion is largely due to conditioning. Such behavior may be addressed through desensitization in virtual environments which in turn may contribute to an endorsement of the view that climate change is occurring and must be dealt with. The issues of Nature Exposure Sufficiency and Insufficiency are intertwined with the sustainability of the planet and future planning and efforts to deal with the environment. If the outcome is unfavorable, the descent of civilization will be more rapid than the ascent.

Introduction

With events in 2017 such as the United States of America withdrawal from the Paris Agreement [1] and the breaking off of an iceberg the size of Delaware State off the coast of Antartica [2], and unprecedented hurricane activity in the Caribbean, there is growing concern about humanity's relationship with nature. Because of increasing urbanization and fossil fuel consumption there is a need for humanity to acknowledge manmade climate change [3].

Articles appearing in National Geographic [4] and Time [5] in 2016 informed the broad readership of these magazines of the numerous mental and physical benefits of being in and experiencing nature which is what we propose calling Nature Exposure (NE). The therapeutic benefits of nature should come as no surprise in that humanity has a fundamental affinity for living things (i.e., biophilia) as well as vegetation (i.e., phytophilia) [6]. Clearly, the endorsement and recommendation of NE is deeply rooted historically and cross-culturally [7]. For example, Indigenous people from many areas of the world, historically and contemporarily, recognize nature as creating and sustaining life, and it lies at the centre of their world views and

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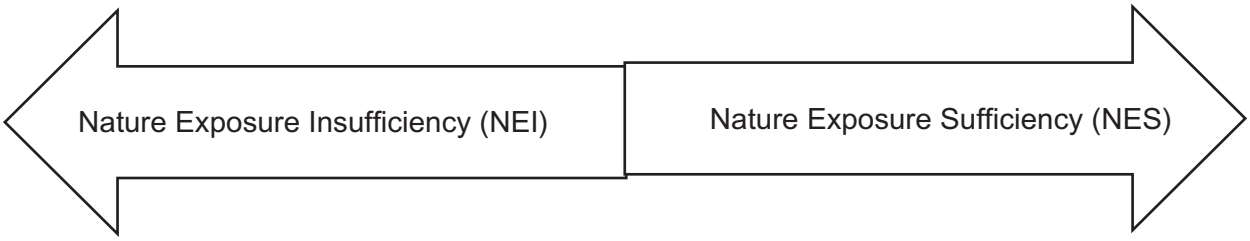

Fig. 1. Nature Exposure (NE) Continuum.

spiritualties.

Historical and cross-cultural benefits of nature exposure

The restorative qualities of NE can be traced back to our paleothic beginnings [8–10]. In 300 BCE, the Greeks became enamored by the cult of Asclepius who proclaimed that nature had profound healing powers [7]. It was with this perspective that some of the first sanitariums were constructed in valley locations near forests and hot/cold springs [7]. The placement of hospitals by water facilitated a symbolic cleansing of the spirit. Additionally, people were sometimes exposed to compounds that aided in their health improvement. For example, the presence of salts such as lithium and minerals such as magnesium in the Dead Sea and ancient baths provided therapeutic benefits for various ailments.

In the Middle Ages, infirmaries were located adjacent to monasteries with courtyards or gardens [7,11]. Patients were placed in rooms with windows facing the courtyards to allow for contemplation and connection to the natural setting [7,11]. Moreover, patients were treated with herbs with medicinal properties that were grown in the gardens.

During the 19th century, Florence Nightingale [12] asserted in several foundational nursing books that fresh air, open windows with a view, and flowers aided in the improvement of patients' wellbeing. Nightingale was inspired by the 18th century French Pavilion hospital design which made use of the natural environment as a therapeutic tool [7]. Nature inherently has three positive characteristics in the pavilion design for health improvement: exposure to fresh air, sunlight, and a tranquil green setting [7]. The concept of "bad air" (e.g., mal-air-ia) has been prevalent in ideas about the cause and transmission of illnesses since Hippocrates [13]. The notion of fresh air was a plausible healing treatment because NE would involve airborne phytochemicals emitted from trees that improve mental and physical wellbeing [5]. Unfortunately, from the 20th century onwards hospitals have increasingly adopted designs with less NE due to their location in more urban settings [7]. It was not until the late 1970s that Planetree (a nonprofit organization) transformed many healthcare settings into more natural environments more conducive to healing [7]. Generally, improved hospital layout and more NE opportunities result in better wellbeing for patients and staff [14–22].

Beyond an attention to where hospitals should be placed with respect to patient wellbeing, a shift was taking place in the 19th century about the co-existence between growing metropolises and natural settings. Frederick Olmsted (1822–1903) [23–27] after acquiring a farm with his father's help in 1848 went to England in 1850 to review farming practices [24]. While in Liverpool he visited Birkenhead Park which was the inspiration for Central Park in New York and subsequently Yosemite National Park in California as well as several other parks. He was adamant that NE improves health and wellbeing [5,23–27]. As he observed "It therefore results that the enjoyment of scenery employs the mind without fatigue and yet exercises it, tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system" [27]. Olmsted would later broaden his view of NE to that of its benefits in communities with the creation of the unified lawn. Olmsted's work in Riverside, Illinois in 1868 contributed to the widespread adoption throughout North America of the landscape design whereby homes were set back 30 feet from the road. Thirty feet enabled the development of lawns with trees, shrubbery, and flower beds. The unified lawns not only made communities more attractive, but facilitated each dwelling's connection with nature.

Hypothesis

Nature exposure sufficiency and insufficiency

We are proposing that attention be called to the benefits of nature by using the term Nature Exposure Insufficiency (NEI) due to insufficient NE. Insufficiency, we believe, is an appropriate term because it denotes reduced function on a continuum rather than deficit or disorder which implies a discrete syndrome with specific diagnostic criteria. The other end of this continuum involves individuals who live in real and/or simulated habitats that are sufficient in nature exposure. These individuals are experiencing what we propose calling Nature Exposure Sufficiency (NES) Fig. 1.

Treatments for nature exposure insufficiency

Rosenthal and colleagues first described Seasonal Affective Disorder (SAD) in 1984 [28] which led to its incorporation into the DSM-III-R, DSM-IV, and DSM-5 of "seasonal pattern" a specification for mood disorders [29]. Many people report SAD in the winter months because of the lack of daylight which results in a lower sense of mood, cognition, and energy [28]. Clinicians have generally treated these individuals with full spectrum artificial light therapy. However, decreased mood, cognition, energy, and physical health may not necessarily be a result of change in season and deprivation of sunlight exposure per se. Instead it may result from insufficient NE.

Treatments for NEI are numerous and can involve direct [13,30–31] or indirect [32–34] contact with nature. The Japanese in the 1980s called for citizens to forest bathe (shinrin-yoku) which is the practice of strolling through forests for better physical and mental health [5]. This suggestion not only allowed for physical activity, but also allowed individuals to inhale phytoncides which are emitted by the surrounding trees [5]. These airborne phytochemicals act in a similar way to aromatherapy whereby individuals feel better physically and mentally [5].

Louv, an advocate for NE in childhood education, argued that to enrich happiness and health, families and communities must combat Nature-Deficit Disorder (NDD) with direct contact with nature [35–37]. NDD and NEI are similar in that they emphasize nature as a viable treatment, however, NDD inherently suggests that there is an abnormality with specific diagnostic criteria. Nevertheless, Louv reports that many parents who have placed their children in educational programs that have utilized NE witnessed noticeable decreases in stress levels and hyperactivity. This observation has been confirmed empirically with children who have been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) [38]. Children with ADHD aged

7–12 years old were given individually guided 20 min walks in the following settings: an urban park, downtown, and residential areas. Before and after the guided walks the children completed a series of puzzles that measured concentration and impulse control [38]. The study indicated that children with ADHD concentrated better and performed better on the puzzles after walking in the urban park compared to the downtown and residential areas.

It can be inferred that nature's restorative effect [3–8,10–19,35–36,39–40] has a neurological component to it that allows for changes in brain processes that result in positive reports [40–43]. Walking in nature not only results in facilitating attention and exposure to various phytochemicals, it may also decrease rumination [40]. Depressed individuals often ruminate (i.e., they have a prolonged and maladaptive cognitive focus on negative emotions about the self). In neurological studies, the subgenual prefrontal cortex (sgPFC) has shown elevated activity in people who are experiencing sadness, and negative self-regard (rumination) [40]. To decrease activation of the sgPFC in people with depression, 90 min walks in nature have shown decreases in neural activity and reports of reduced rumination.

Nature can also increase blood flow to areas of the brain [40] through active or indirect exposure. The sun naturally increases blood flow when people go on walks by elevating body temperature. In general, people feel better when they experience warmth and this could contribute to reports of increased happiness after nature walks. In addition, NE has shown increases in heart rate variability, and lower blood pressure and cortisol [4,5,44–45]. A Korean study measured emotional status by self report and measured brain activation through measurements of blood flow when people were presented urban or natural scenic views. In terms of self report the natural scenes were preferred. When people were shown natural scenic views, blood flow and brain activation increased in the cingulate and insula areas [42]. In contrast, when people were presented urban scenic views the amygdala was activated. It is important to note that these areas of the brain are part of the limbic system which is involved in emotional response [42]. Amygdala activation in this case is associated with fear and anxiety which suggests that urban scenes could potentially promote unpleasant emotions [4,42]. Conversely, nature scenes activated areas of the brain associated with empathy and altruism [4,42]. This may explain reports of improved connectivity with the environment and others after NE [4,40].

People may be more willing to preserve the environment and become more selfless because nature facilitates a holistic appreciation of the individual's rapport with their surroundings. One way healthcare providers can encourage this holistic appreciation is by engaging clients in gardening activities (i.e., horticultural therapy) [11,43,46–51]. Numerous studies about the benefits of horticultural therapy have consistently shown that exposure to nature allows for introspection and reinvigorates the mind and body. For example, Morley, in an examination of emerging treatments for Alzheimer's Disease, reported that gardening improved memory and reduced agitation in patients with Alzheimer's Disease [43].

An additional and viable candidate for treatment is NE through virtual reality [4,39,52]. Clinicians could make their clients aware of the benefits and availability of nature through virtual NEs such as listening to animal noises, watching nature videos, and/or playing video games that place the player in a nature setting. A Swedish study that utilized a 3D virtual reality room, with natural scenes and birdsongs, found that individuals felt less stress after their experience in the virtual nature setting [4,52]. Virtual NE is in its infancy, but could have similar benefits to a Snoezelen or comfort room where through sensory stimulation a soothing and awe-inspiring experience is provided [53].

Nature Exposure Aversion (NEA)

Some people have an aversion towards nature. Past experiences may conjure up thoughts and feelings of discomfort rather than bliss. For example, bothersome insects, exposure to inclement weather, and sacrificing conveniences such as modern plumbing. These discomforting experiences are paired with negative thoughts and feelings (e.g., disgust, fear) which are deeply ingrained and become conditioned responses for the individual(s). We are thus proposing the term Nature Exposure Aversion (NEA) for those behaviours which preclude directly experiencing nature. In order to overcome NEA a virtual desensitization process may be worthwhile to try. The desensitization process may also convert climate change deniers into advocates for the preservation of the environment and of ways in which climate change can be dealt with.

Nature exposure in hospital design and patient wellbeing

Our own facility, Alberta Hospital Edmonton (AHE) which opened in 1923, is currently an 80 acre (i.e., one third of a square kilometer) property still located on the outskirts of the city of Edmonton, Alberta with presently no adjacent residential or commercial properties. AHE contains hundreds of trees, flower beds, and a substantial garden. Patients and staff can interact with nature around the hospital and through the Friendship Trail. Often staff have patients walk the trail in the morning (weather permitting). In addition to NE, the mechanisms for improved mood involve physical activity as well as interpersonal interaction [40]. This trail is similar to power trails in Finland that promote improvements in mental and physical health [54]. Another major NE feature at AHE is the greenhouse which employs patients who maintain vegetable crops and flowers for profit. In a similar way to Morley's findings [43], the garden promotes calmness amongst patients through NE. AHE also extends NE to its interior with the placement of several indoor plants in patient units and around the hospital's several buildings to maintain NE year-round [3,6]. It is our view that AHE's natural environment is more mentally and physically beneficial than many urban hospital settings in which NE may be limited. Some urban hospitals, however, such as the renowned Veteran Centre at Sunnybrook Hospital in Toronto, Ontario has facilitated NE by incorporating gardens, flowers, shrubbery, trees, greenhouses, etc. into the architecture. Also, patients have the opportunity to grow and care for flowers and vegetables of their own choice if able. There are multiple therapeutic benefits including stress reduction, mood elevation, and increased physical activity. Creating such an environment was much easier when land in urban areas was more readily available. Currently, achieving a substantial integration with nature is challenging.

Conclusion

With the ever-increasing encroachment of humanity on nature, we are limiting and even eradicating opportunities for NE [39]. It is becoming empirically clear that actual and virtual NE contribute not only to improved wellbeing but also improved connections with and transactions with our environment [4,5,39]. Using the term NEI will not only serve as a way to ameliorate mental and physical health with concomitant economic benefits, but it will motivate further dialogue and action in the area of NE. Similarly, the term NEA for Nature Exposure Aversion will stimulate dialogue and help change attitudes and behaviours about nature and climate change. Humankind's future success hinges on the preservation of nature so that NE and humanity can persist otherwise the descent of civilization will be more rapid than the ascent.

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